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TM 11-332

WAR DEPARTMENT

U.S. Dept of Army

TECHNICAL MANUAL

TELEPHONE CENTRAL
OFFICE SET TC-4

June 1, 1942

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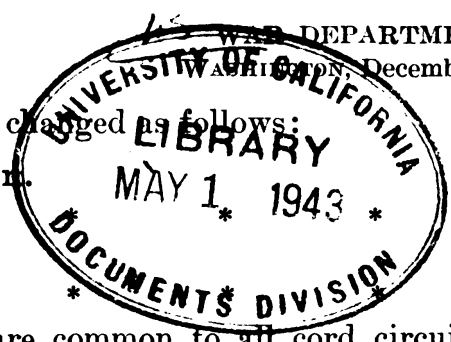
1942

TECHNICAL MANUAL



TELEPHONE CENTRAL OFFICE SET TC-4

CHANGES }
No. 1 }



WAR DEPARTMENT,
WASHINGTON, December 14, 1942.

TM.11-332, June 1, 1942, is changed as follows:

6. Switchboard operation.

* * *

f. Grouping key.

* * *

(3) The A and B leads are common to all cord circuits in the switchboard (see fig. 9) and are used to complete the operator's transmitter battery circuit (see figs. 11 and 11½) whenever a key is operated to the TALK position. Switchboards other than those manufactured under the order numbers mentioned in (2) above are wired as shown in figure 11½. With the grouping key thrown, it is thus necessary to operate only the talk key on the unattended switchboard in order to obtain transmitter battery at the attended switchboard. In the switchboards manufactured under these order numbers, operation of the grouping key does not provide for transferring the A and B leads from the unattended switchboard to the attended switchboard as shown in figure 11; thus, when the grouping key * * * in order of preference:

* * * * *

[A. G. 062.11 (11-20-42).] (C 1, Dec. 14, 1942.)

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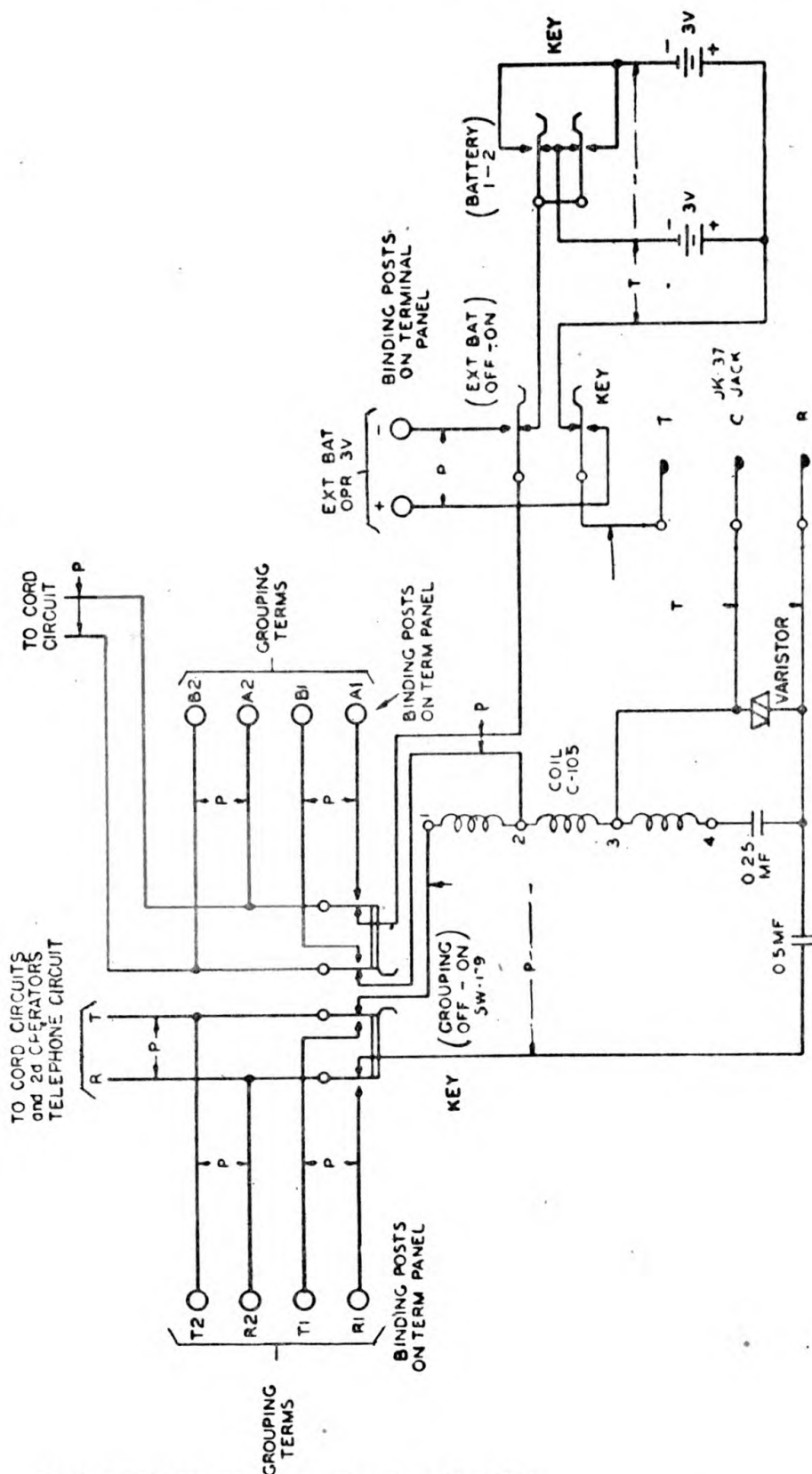


Figure 111½.—First operator's telephone circuit.

[A. G. 062.11 (11-20-42).] (C 1, Dec. 14, 1942.)

Figure 15 is rescinded and the following is substituted therefor:

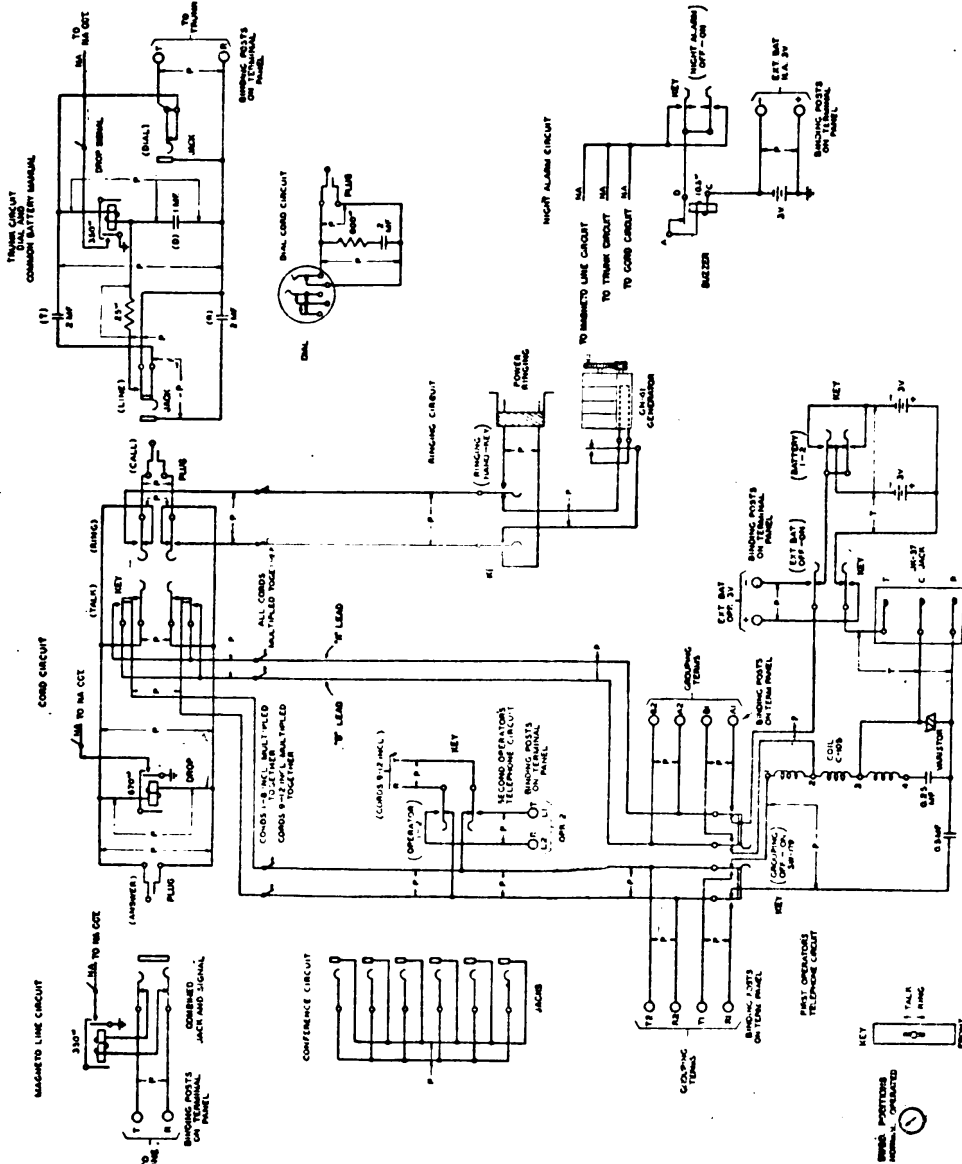


FIGURE 15.—Switchboard BD-96, master schematic diagram.

[A. G. 062.11 (11-20-42).] (C 1, Dec. 14, 1942.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

TECHNICAL MANUAL

TELEPHONE CENTRAL OFFICE SET TC-4

CHANGES

No. ~~1~~ 2

(45) WAR DEPARTMENT,
WASHINGTON 25, 15 July 1943.

TM 11-332, 1 June 1942, is changed as follows:

All references to Telegraph Central Office Set TC-3 appearing in C 2, 12 May 1943, are hereby rescinded.

[A. G. 300.7 (23 Jun 43).] (C 1, 15 Jul 43.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
*Major General,
The Adjutant General.*

TECHNICAL MANUAL)
No. 11-332)

WAR DEPARTMENT
Washington, June 1, 1942

TELEPHONE CENTRAL OFFICE SET TC-4

SECTION	I.. GENERAL	Paragraphs
	Purpose-----	1
	Component parts-----	2
	General description-----	3
II.	EMPLOYMENT	
	Equipment layout-----	4
	Setting up and connecting equipment-----	5
	Switchboard operation-----	6
III.	DETAILED FUNCTIONING OF PARTS	
	Switchboard BD-96-----	7
	Magneto line circuit-----	8
	Trunk circuit, dial and common battery manual-----	9
	Cord circuit-----	10
	Ringing circuit-----	11
	First operator's telephone circuit-----	12
	Second operator's telephone circuit-----	13
	Night alarm circuit-----	14
	Conference circuit-----	15
	Master schematic diagram-----	16
	Panel BD-97-----	17
	Power ringer, 20-cycle-----	18

IV. SERVICING AND REPAIR

Maintenance-----	19
Packing for army transportation-----	20

V. REPLACEMENT PARTS

List of parts-----	21
Addresses of manufacturers-----	22

SECTION I

GENERAL

	Paragraph
Purpose-----	1
Component parts-----	2
General description-----	3

1. PURPOSE. - The switching central, telephone central office set TC-4, is designed for use at division or other headquarters which require a telephone switchboard of the capacity of switchboard BD-96 as described in paragraph 3 a.

2. COMPONENT PARTS. -

<u>Quantity</u>	<u>Article</u>	<u>Approximate Shipping Size (Inches)</u>	<u>Approximate Weight (Pounds)</u>
1	Switchboard BD-96	15x22x25	200
1	Panel BD-97	11x24½x27½	150
20	Batteries BA-30; 10 in use, 10 spare	2½x1½ dia.	½
1	Cord CD-258	(50 ft. long)	10
1	Cord CD-451	(20 ft. long)	1
1	Ground rod GP-16	24x½ dia.	1½
2	Head and chest sets HS-19		2
1	Maintenance equipment ME-11	20x39x19	200
1	Paulin, duck (type I) 12.3 ft x 16 ft., equipped with not less than 10 grommets with 5½ ft. tie ropes	36x24x18(folded) 4x7½x10	55 9½
2	Telephones EE-8-A		
Total weight approximately -----			646

3. GENERAL DESCRIPTION. - The complete installation is shown in figures 1 and 2. Figure 1 shows switchboard BD-96 ready for operation, and figure 2 shows panel BD-97 set up for operation.

a. Switchboard BD-96. - The switchboard is a complete, transportable, single-position, manually operated telephone switchboard for serving magneto line traffic as well as originating and terminating trunk line and ring-down tie line traffic. Trunk circuits are provided which may be used for connection to common battery lines of either manual or automatic central offices. Drop signals are provided for the lines and trunks and are associated with each cord for recall signals. The line jacks are wired to a binding post panel in the top of the switchboard which provides for connections with spade-terminal strips through rubber jacketed cable to a panel BD-97 (main distributing frame). Facilities are provided for using two telephone central office sets TC-4 combined as a single office. The batteries which supply current for talking and for the night alarm buzzer are inserted in the rear of the switchboard. Terminal facilities are provided in the top of the switchboard for ringing current, grouping, a second operator, and external battery. Each switchboard contains the following:

- 1 First operator's telephone circuit with grouping key
- 12 Cord circuits
 - 1 Ringing circuit
- 40 Line circuits, magneto
 - 4 Trunk circuits, common battery manual or dial
 - 1 Dial cord circuit
 - 1 Conference circuit
 - 1 Night alarm circuit
- 1 Second operator's telephone circuit

In operating position the approximate size of the switchboard is 15 x 22 inches x 47 inches high. The switchboard is arranged to be packed within the angle iron base; therefore a separate packing case is not necessary for Army transportation.

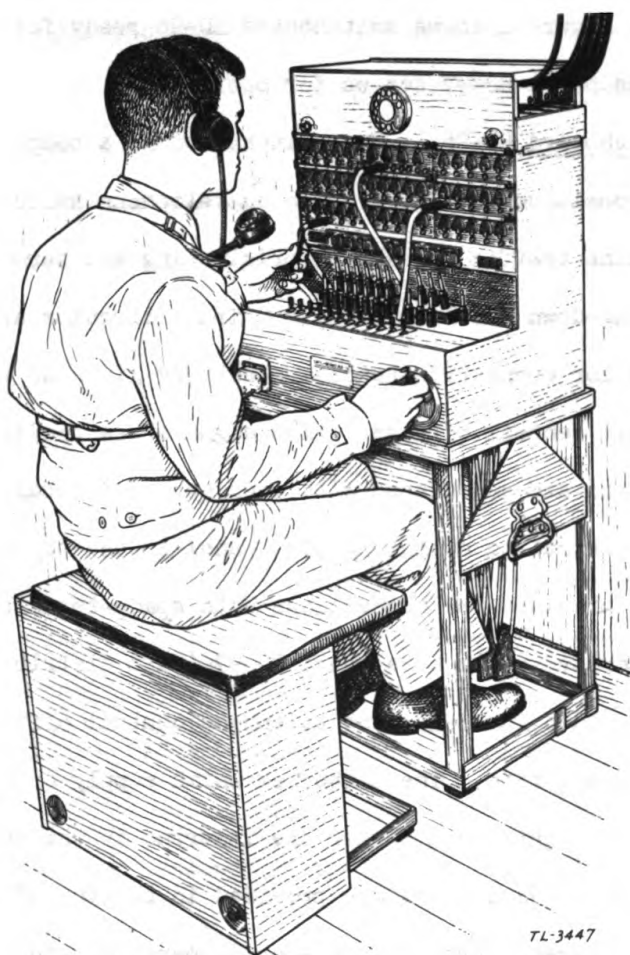


Figure 1. - Switchboard BD-96 ready for operation.

b. Panel BD-97. - The panel BD-97 is a main distributing frame unit for use with one switchboard BD-96. It is equipped with commercial types of high-potential and sneak-current arresters which are wired to binding posts for the incoming lines. The connections between the panel BD-97 and switchboard BD-96 are made with rubber jacketed cables wired directly to the protectors on the panel and equipped with spade-terminal cable connectors (terminal strips) at the switchboard. A 20-cycle power ringer is mounted in the panel for ringing current when 110-volt, 60-cycle power is available. The cabinet is equipped as follows:

Line side. - Protectors consisting of 1-ampere fuses and protector blocks (unit dischargers) in two verticals of 22 pairs each.

Switchboard

side. - Three 15-pair cables (44 pairs and ground wire).

Coil rack. - Eight coils C-161.

Lower panel. - One 20-cycle power ringer.

In operating position the approximate size of the panel is 11 x 24½ inches x 55 inches high. A separate packing case is not necessary for Army transportation.

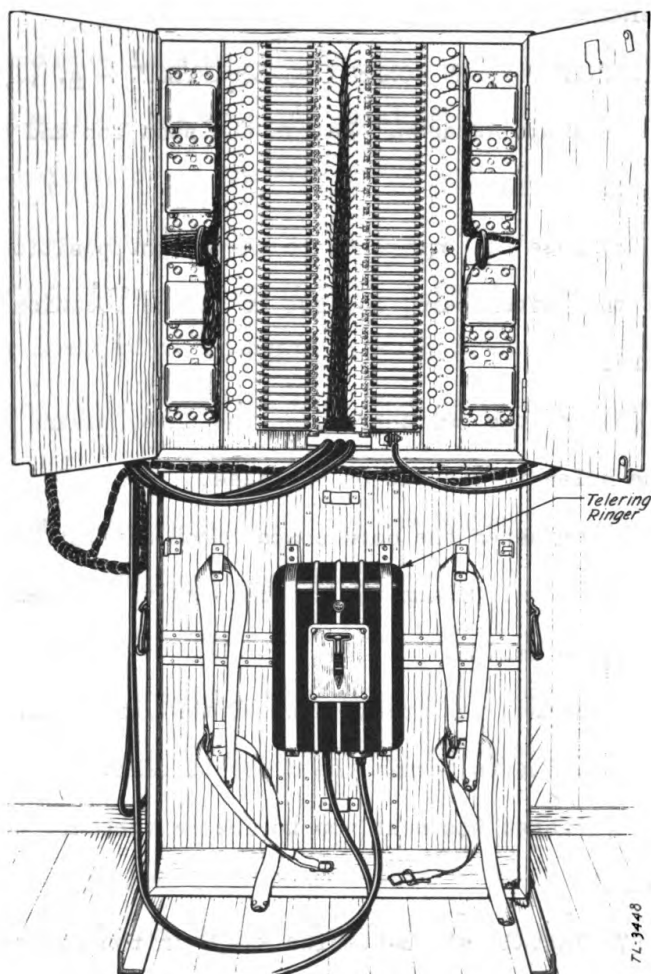


Figure 2. - Panel BD-97 ready for operation.

Signal Corps

SECTION II

EMPLOYMENT

	Paragraph
Equipment layout-----	4
Setting up and connecting equipment-----	5
Switchboard operation-----	6

4. EQUIPMENT LAYOUT. - Before starting any installation, decide upon the general layout of the equipment in view of the local conditions. Within the limitations of the cable lengths the local conditions will determine the layout.

5. SETTING UP AND CONNECTING EQUIPMENT. - a. (1) Turn the switchboard and base upside down. Remove the seat top and extend the extension legs of the base.

(2) Ease the equipment to an upright position. Lift the base from over the switchboard, and set it in the location desired for the switchboard.

(3) Set the switchboard on the base, making sure the dowels fit in the holes in the top of the base.

(4) Unfasten the cord compartment and let the cords and weights drop into position. Clamp the switchboard to the base by means of the two wing nut bolts.

(5) Remove the front cover of the switchboard and raise the designation strips to permit the drops to fall.

(6) Fasten the seat top to the switchboard cover for an operator's chair.

(7) Install six batteries BA-30 in the compartment in the lower back of the switchboard.

(8) Inspect the switchboard for damaged or loose parts.

(9) When two switchboards are to be used together in adjacent

positions, connect grouping terminals T1 and R1 in each switchboard to terminals T2 and R2 of the other switchboard.

b. (1) Set the main distributing frame panel BD-97 in the desired location within cabling distance of the switchboard. Loosen the bars on the outside of the case and raise the upper half of the panel (the half without the handles) until it is vertical. Fasten the two lower bars of the upper cabinet to the top bolts of the lower cabinet as a brace.

(2) Unstrap the cables and remove the two angle irons chained to the panel. Fasten these angle irons to the bottom of the lower cabinet as extension legs to make the panel stable. Slots are provided in the angle irons for mounting panel BD-97 either in the center of the angle irons, or at the end of the angle irons when the panel BD-97 is standing against a wall.

(3) When desired, the upper cabinet can be detached and suspended on a wall by means of the hangars at each corner. The 20-cycle power ringer also can be removed from the lower cabinet and hung on a wall when desired.

(4) Connect the three cables to the three rows of binding posts in the top of the switchboard as designated.

(5) Install the ground rod and connect it to the ground terminal of panel BD-97. Connect the incoming lines to the binding posts in the upper cabinet, wiring through the repeating coils when desired.

c. Terminal and jack numbering. - Line terminals are numbered from 0 to 34 and 39 to 43, inclusive. Trunk terminals are numbered from 35 to 38 inclusive. Terminal numbers correspond to line and trunk numbers appearing on the face of the switchboard. (See fig. 3.)

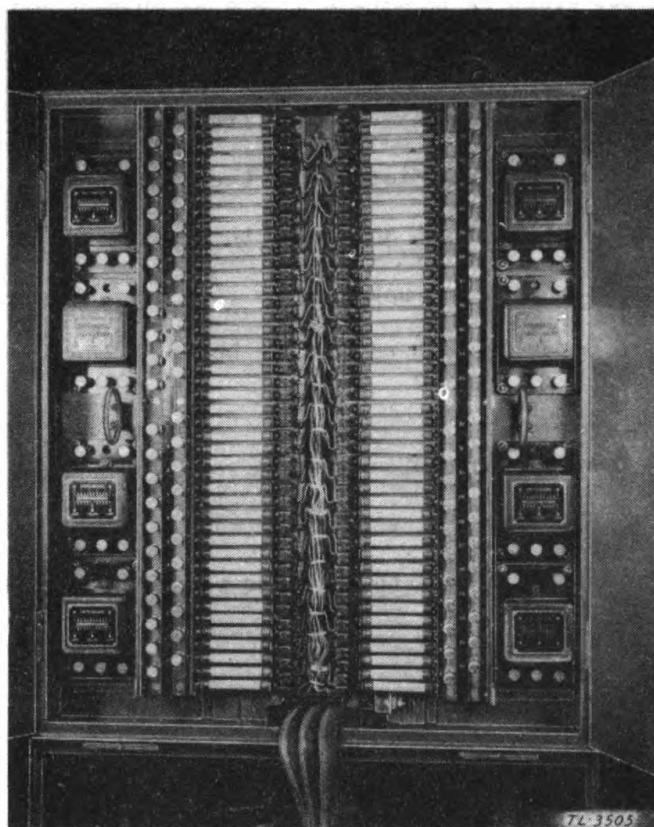


Figure 3. - Panel BD-97, protector and terminal panel.

d. Ground terminal. - The ground terminal in panel BD-97 appears just below the right-hand group of protectors. (See fig. 3.) Cord CO-258 is used to make the connection between the ground terminal in panel BD-97 and the ground rod. Pair number 44 in cords CD-427 is permanently connected to the ground terminal and is used to extend the ground lead from panel BD-97 to switchboard BD-96.

e. Test the local commercial power circuit, if available, and determine whether it is alternating current or direct current. If 110-volt, 60-cycle, alternating current is available, plug the ringing machine cord into a convenient outlet. Extend ringing current to the switchboard by means of cord CD-451. The connector at the switchboard is located on the panel in the top of the switchboard.

6. SWITCHBOARD OPERATION. - a. The operation of the switchboard is characteristic of comparable commercial practice. See figure 4 for layout of face and keyshelf equipment.

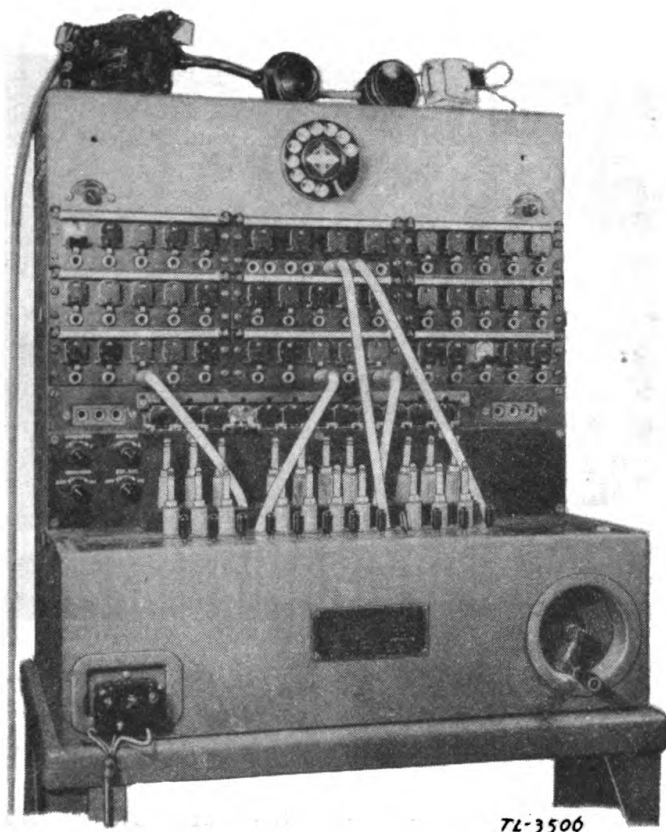


Figure 4. - Switchboard BD-96, face and keyshelf equipment.

b. Incoming calls. - The drop signals indicate a call on a line or trunk. When a call is received, insert the answering (back) plug in the jack associated with the signal and connect the operator to the circuit by operating the TALK-RING key associated with the cord used to the locking TALK position (away from the operator).

c. Outgoing calls. - To call a number, insert the calling (front) plug in the desired party's line and operate the key associated with the cord used to the nonlocking RING position (towards the operator). If the power ringer is not operating, turn the hand generator

while holding the key operated to the RING position.

d. Supervision. - Supervision is provided by drops which are located on the face of the board directly above the associated plugs. Ring-off or recall is indicated by these drops falling.

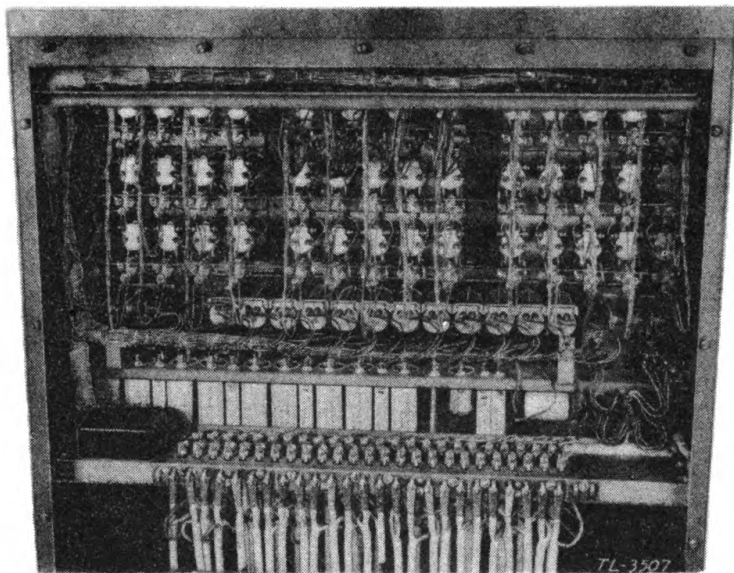


Figure 5. - Switchboard BD-96, rear equipment.

e. Night alarm. - An audible signal is provided by means of the night alarm circuit when desired. Operation of the night alarm key, marked NIGHT ALARM OFF-ON, to the OFF position prevents the audible signal from functioning.

f. Grouping key. - (1) A grouping key, marked GROUPING OFF-ON, is provided so that an operator may, during periods of light traffic, use the cords of an adjacent switchboard when two such switchboards are used together. This obviates the necessity of transferring the operator's set to the adjacent board, to establish or supervise connections, when only one operator is on duty.

(2) In all switchboards manufactured under the following order numbers, it will be necessary, due to conditions described in paragraph (3) below, to use one of several nonstandard operating prac-

tices in order to take advantages of the grouping circuit; 100-CHI-41, 6560-NY-41, 6565-NY-41, and 1111-NY-42. The order number appears on the name plate on the front of the keyshelf.

(3) The A and B leads are common to all cord circuits in the switchboard (see fig. 9) and are used to complete the operator's transmitter battery circuit (see fig. 11) whenever a key is operated to the TALK position. In the switchboards manufactured under the order numbers mentioned in (2) above, operation of the grouping key does not provide for transferring the A and B leads from the unattended switchboard to the attended switchboard; thus, when the grouping key is operated on the unattended switchboard position the operator at the attended position will not get transmitter battery due to operation of a key to the TALK position on the unattended switchboard. The operation of his own position of switchboard is not affected, however. Following are several ways of overcoming this difficulty, in order of preference:

(a) Reserve one cord circuit on the attended switchboard. Operate this key to the TALK position at the same time the key on the unattended switchboard is operated to the TALK position. This operation will close the transmitter battery circuit on the attended position and the operator may then talk on the connection on the unattended switchboard. Both TALK keys should be restored at the same time. The ringing circuit of the unattended switchboard is not affected by the grouping key.

(b) A second method involves the use of a telephone EE-8-A in place of the operator's set. In this method the grouping keys of both switchboards are operated and the telephone EE-8-A connected to the T1 and R1 or T2 and R2 terminals of either switchboard.

(c) A third method is to connect permanently the A and B leads together on the switchboard that will be attended. This method

causes an abnormal battery drain because the transmitter battery circuit is closed at all times the operator's set is in the jack.

(4) The switchboard cords are of sufficient length to reach any jack on an adjacent switchboard. It will often be possible to operate two switchboards entirely by means of the cord circuits on the attended switchboard, thus obviating the necessity for using the grouping circuit.

g. Second operator's telephone circuit. - A key, marked OPERATOR 1-2, is provided for disconnecting cord circuits 9 to 12 inclusive, from the operator's telephone circuit and transferring them to the second operator's telephone circuit during periods of heavy traffic. The second operator uses a telephone EE-8-A for an operator's set. Terminals for connecting the second operator's telephone set are located in the top of the switchboard.

h. Trunk calls, dial. - Answer the local station in the usual manner, using an answering cord. Insert the corresponding calling cord in the desired trunk line jack (engraved L), and listen for dial tone. When dial tone is heard, plug the dial cord into the associated dial jack (engraved D) and dial the number. Remove the dial cord and listen for ringing tone. It is not necessary to ring on the trunk.

i. Trunk calls, common battery manual. - Answer the local station in the usual manner, using an answering cord. Plug the corresponding calling cord into the desired trunk line jack (engraved L). The act of plugging in the trunk line jack signals the manual operator, and it is, therefore, unnecessary to ring on the trunk.

j. Trunk calls, supervision. - Care must be exercised in supervising trunk calls involving either dial or manual common battery exchanges, particularly outgoing calls to these exchanges. Momentary interruption of the trunk circuit to these exchanges may result in a

loss of the connection, thus necessitating a complete re-establishment of the call. It may be necessary to monitor the connection occasionally to determine whether the call is still in progress. Since no indication is received from the trunk end of the connection at the completion of a call, a failure of the station to ring off will monopolize the trunk until the condition is observed and disconnection made by the operator.

k. Incoming trunk calls. - An incoming call on a trunk line is answered like any other call.

1. Conference calls. - To connect a number of lines together for conference purposes, the conference circuit is utilized as follows: Insert the plug of an answering cord in the jack associated with the telephone of the person originating the conference. Then, insert the plug of the associated calling cord in a conference circuit jack. Make the other connections to the conference circuit with answering plugs inserted in the conference circuit jacks and the associated calling plugs connected to the desired line circuit jacks. Call each member of the conference in the usual manner. An alternative method of establishing a conference call, utilizing but one cord circuit for the entire conference, is outlined below. The conference connection is established in the following manner; Insert an answering cord plug in the jack associated with the telephone of the person originating the conference, and connect the corresponding calling cord to a conference circuit jack. Establish the other connections to the conference circuit, using the calling cord of another cord circuit and ringing the called party. After the called party answers, remove the calling cord plug from the jack and complete the connection between the called party's jack and the conference circuit by means of a patching cord (not issued as a part of telephone central office set TC-4 - see m below). Complete the connec-

tions to the balance of the stations in the conference in a like manner. Upon completion of the conference ring-off supervision is accomplished as usual, except that there is only one supervisory or ring-off drop involved, this being the signal associated with the one cord circuit in use. This one supervisory drop is operated when any one of the conference stations rings off. Challenge the call in the usual manner to determine if any other connections are desired.

m. Patching cords. - Patching cords consist of two switchboard plugs connected by a piece of switchboard cordage of the desired length. If no standard patching cords are available they may be improvised out of two switchboard cords whose corresponding terminals are securely fastened together and the two conductors insulated from each other. Occasionally, it may be desired to tie circuits through the board in a semi-permanent manner. This may be done by means of patching cords if it is desired to avoid using a cord circuit. It must be remembered, however, that there is no supervision on circuits connected by means of patching cords.

SECTION III

DETAILED FUNCTIONING OF PARTS

	Paragraph
Switchboard BD-96-----	7
Magneto line circuit-----	8
Trunk circuit, dial and common battery manual-----	9
Cord circuit-----	10
Ringing circuit-----	11
First operator's telephone circuit-----	12
Second operator's telephone circuit-----	13
Night alarm circuit-----	14
Conference circuit-----	15

Master schematic diagram-----	16
Panel BD-97-----	17
Power ringer, 20-cycle-----	18

7. SWITCHBOARD BD-96. - a. The switchboard cabinet, base and miscellaneous mechanical details are designed for the mounting and assembly of standard telephone apparatus to form a telephone switchboard suitable for military use. The induction coil, operator's jack, head and chest set, terminal panel, binding posts, and hand generator are of Signal Corps design and are used in other equipment. The remaining apparatus consists of standard commercial parts.

b. The front equipment layout is shown in figure 4. The rear equipment layout is shown in figure 5. The operator's telephone circuit apparatus, dial cord circuit apparatus, and trunk circuit equipment are mounted on a plate running horizontally across the back of the switchboard just above the cord shelf. The capacitors can be removed by first removing the guard under the equipment. The upper part of the switchboard is occupied by the jack and signal equipment. The line binding post panel is mounted in the top of the switchboard. The panel provides 90 binding posts in three parallel rows of 30 binding posts per row. These binding posts are arranged to screw down on the spade-terminal strips attached to the cables which connect to the panel BD-97. The binding post screws should be loosened or tightened only by means of a screw driver. The purpose of the binding post panel is to provide rapid means of connecting the line circuits to the panel BD-97. The binding posts are of a Signal Corps design and arranged to prevent the loss of the binding post screws.

c. In subsequent discussions and manufacturer's drawings furnished with TC-4, frequent reference is made to the terms "tip" and "ring". A brief explanation of the meanings of these terms follows:

The method of designating the two conductors, or sides of a line, as tip or ring is derived from the plug used on a magneto switchboard. One of the cord conductors is connected to the tip of the plug, and the other conductor connected to the ring of the plug. This method of distinction is applied to the line circuit. The tip of the plug makes contact with the short spring of the jack (see fig. 6). This jack spring is designated the tip spring and the side of the line connected to the tip spring is designated the tip side of the line, or tip conductor. The ring of the plug makes contact with a longer jack spring. This longer jack spring is designated the ring spring and the side of the line connected to the ring spring is designated the ring side of the line, or ring conductor.

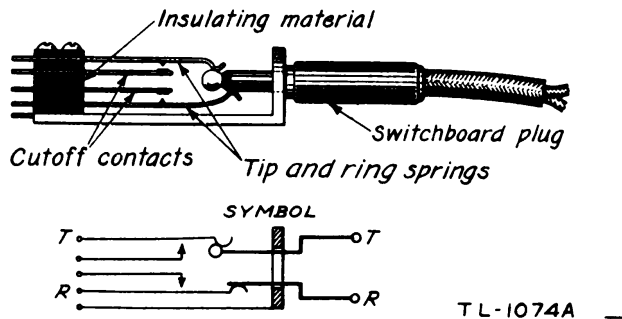


Figure 6. - Two conductors, plug and cut-off jack.

d. Circuits. - The several circuits were designed for use in a magneto switchboard, and are explained in detail in the following paragraphs 8 to 16 inclusive.

8. **MAGNETO LINE CIRCUIT.** - Reference figure 7. The circuit is for use with equipment that uses 16 to 20-cycle ringing current for signaling and may be used as a magneto trunk circuit in addition to being used as a magneto station line circuit. As direct current is not applied to the line through this circuit it cannot be used with telephones or circuits that require an external source of transmitter current (common battery telephones) or that require direct current for supervisory pur-

poses. The application of a ringing current to this circuit from the line causes the drop to fall. When a plug is inserted into the jack, the drop is automatically restored by mechanical means and the winding of the drop is disconnected from the line at the cut-off contacts in the jacks. Contacts are provided on the drop to close a night alarm circuit which provides, when desired, an audible signal when a drop falls. The magneto line circuit may be connected to the following types of equipment:

- a. Military local battery (magneto) telephone such as telephones EE-3, EE-3-B, EE-4, EE-5, EE-8 and EE-8-A.
- b. Commercial local battery (magneto) telephones.
- c. Switchboards, as follows: Magneto line circuits in switchboards BD-14, BD-71, BD-72, BD-80-A, BD-89-A, BD-91, BD-96, and commercial magneto switchboards and common battery switchboards equipped with ring-down tie line equipment.

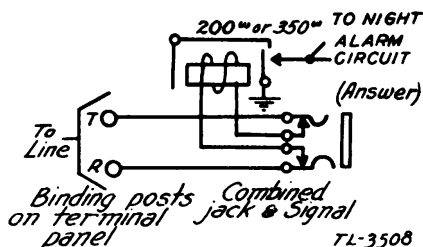
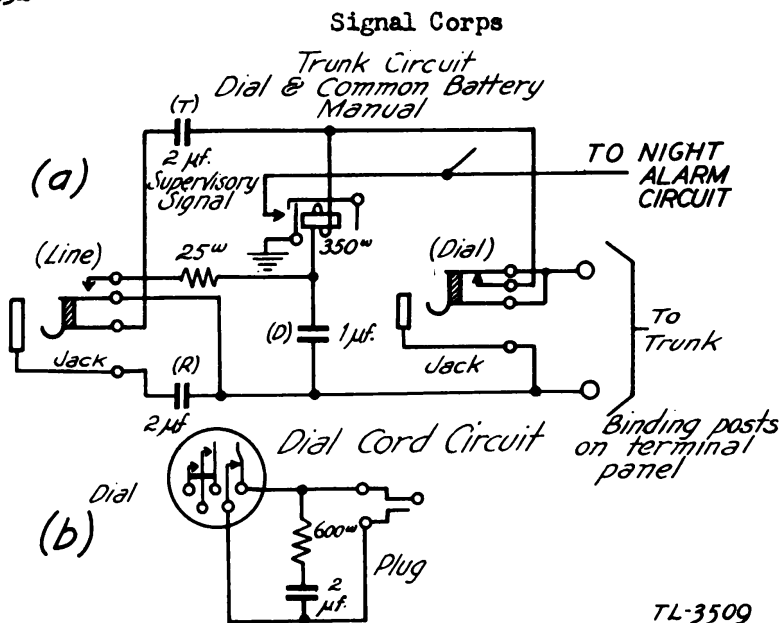


Figure 7. - Magneto line circuit.

9. TRUNK CIRCUIT, DIAL AND COMMON BATTERY MANUAL. - a. Reference figure 4 (jacks in the middle group, top row) and figure 8 (schematic circuit diagram). This circuit is for use with common battery central office equipment of either manual or dial type. It may be connected in place of, or bridged across, any dial telephone or any common battery manual telephone.

b. Working limit. - Supervision limit of central office to which connected, less 375 ohms in the trunk circuit.



TL-3509

Figure 8. - Trunk circuit and dial cord circuit.

c. The application of a 16- to 20-cycle ringing current to this trunk circuit causes the drop to fall and connects ground to the night alarm lead to provide for an audible signal. (See figs. 8 to 13.) Insert an answering plug in the line jack (L) of the trunk circuit, which closes a circuit to bridge the coil of the drop across the line as a holding bridge. This action extends supervision to the central office and cuts off automatic ringing current if it is used.

d. On outgoing common battery manual trunk calls, insert the calling plug in the line jack (L) of the trunk circuit (see fig. 8a), which places the coil of the drop across the trunk, extending supervision to the central office without the necessity of ringing on the trunk.

e. On outgoing dial trunk (automatic) calls, insert the calling plug in the line jack (L), which connects the coil across the line, seizing the central office equipment. Insert the dial cord plug (see fig. 8b) in the dial jack (D) (see fig. 8a), which disconnects the drop coil from the trunk and closes a holding bridge for the trunk through the dial-impulse springs. Dial the desired number, which causes the

switch train at the central office to complete the connection. After the dialing is completed, the dial cord is removed from the dial jack (D), and the trunk is again held through the drop coil.

f. When the plug is removed from the jack upon completion of a call, the trunk-holding bridge is opened signaling the central office operator in the case of a manual call or allowing the central office equipment to release in the case of a dial call.

10. CORD CIRCUIT. - a. Reference figure 9. These cord circuits are limited to use with magneto lines, that is, at least one line to which the cord circuit is connected must use ringing current for recall and disconnect signals. Disconnect or recall signals are provided by a supervisory drop associated with each cord. These drops are located in the face of the switchboard.

b. When, on incoming calls, the plug of the answering cord is inserted in the line jack the supervisory signal is bridged across the tip and ring of the cord for ring-off supervision. The operator answers the call with the TALK-RING key in the TALK position.

c. On outgoing calls the plug of the calling cord is inserted into the line jack. Except when ringing, the TALK-RING key is operated to the TALK position until connection has been made to the called station. Upon operation of the key to the RING position, ringing current is applied to the line if the ringing machine is operating or the circuit is prepared for the operation of the hand generator.

d. When a conversation is completed, ringing current should be applied to the line by the telephone user or distant switchboard operator. The ringing current from the distant end of the line will operate the supervisory signal, thus providing a disconnect signal. When the common-battery trunk is used, ringing current for the operation of the supervisory signal must be supplied over the magneto line

e. Operation of the TALK-RING key to the TALK position connects the A and B leads together and completes the transmitter battery circuit of the operator's telephone circuit. (See figures 9 and 11.)



11. RINGING CIRCUIT. - Reference figure 10. This circuit provides ringing power from equipment in panel BD-77 or from the hand generator. The outlet for connecting the power ringer is located in the top of the switchboard. A key for switching on either the hand generator or power ringing is located in the upper right-hand corner of the face equipment and is marked: RINGING HAND-KEY. The hand generator is Signal Corps generator GN-41.



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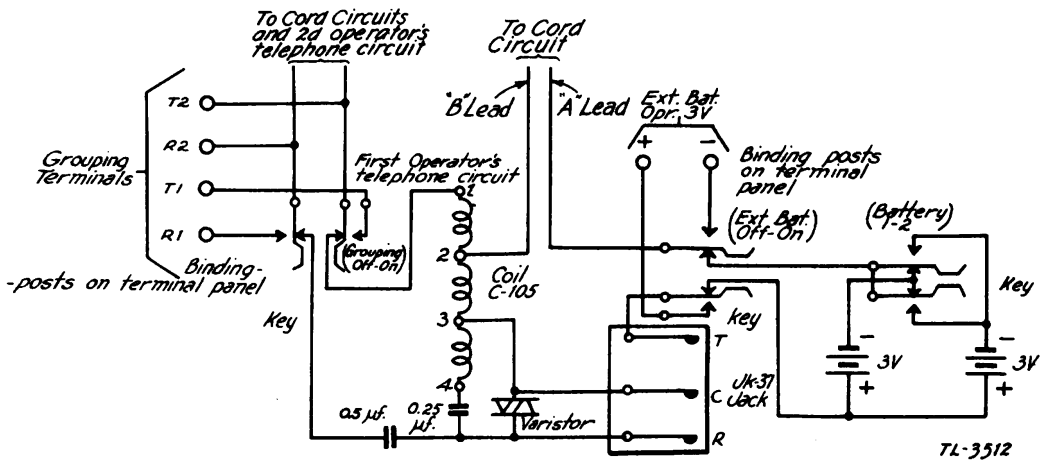


Figure 11. - First operator's telephone circuit.

12. FIRST OPERATOR'S TELEPHONE CIRCUIT. - Reference figure 11.

An anti-sidetone telephone circuit using induction coil C-105 is used in this switchboard. A varistor is bridged across the receiver terminals to reduce the acoustic shock to the operator caused by excessive voltages across the receiver terminals. The varistor consists of an arrangement of copper-oxide disks, the resistance of which decreases as the voltage increases, thus reducing the current through the receiver. A grouping key is provided so that through its operation the cords of this switchboard may be associated with the operator's circuit of an

adjacent switchboard at such times as this switchboard is unattended. The grouping key is mounted in the lower left-hand corner of the face equipment. Also provided in this location are keys for switching between transmitter batteries 1 and 2 and for switching to an external transmitter battery. The grouping terminals and external battery terminals are in the top of the switchboard. (See paragraph 5a for connections for grouping circuit.) Head and chest set HS-19 may be connected to the operator's telephone circuit by placing its plug PL-58 in the jack JK-37 located on the left front of the keyshelf.

13. SECOND OPERATOR'S TELEPHONE CIRCUIT. - Reference figure 12.

This circuit provides for transferring the last four cord circuits to a second operator when traffic on the switchboard warrants. Terminals for connecting a telephone EE-8-A or similar local battery telephone for the use of the second operator are located in the top of the switchboard. The key for transferring the cord circuits is located in the lower left-hand corner of the face equipment, and is marked: OPERATOR 1-2.

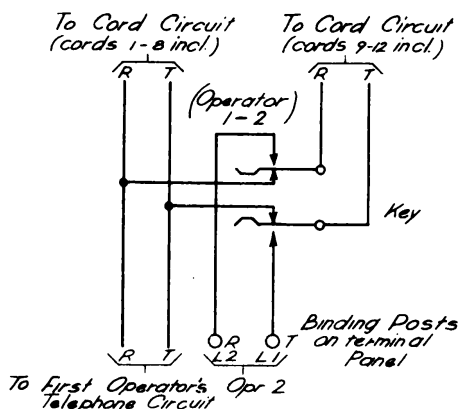


Figure 12. - Second operator's telephone circuit.

14. NIGHT ALARM CIRCUIT. - Reference figure 13. This is a conventional night alarm circuit in which the operation of a drop signal completes a circuit from ground through the night alarm buzzer to negative battery, thereby giving an audible signal. The battery is normally in the

battery compartment in the back of the switchboard. Terminals for an external battery are in the top of the switchboard. When an external battery is used, no battery should be left in the compartment. The key which controls the operation of the night alarm is located in the upper left-hand corner of the face equipment and is marked: NIGHT ALARM OFF-ON.

Night Alarm Circuit

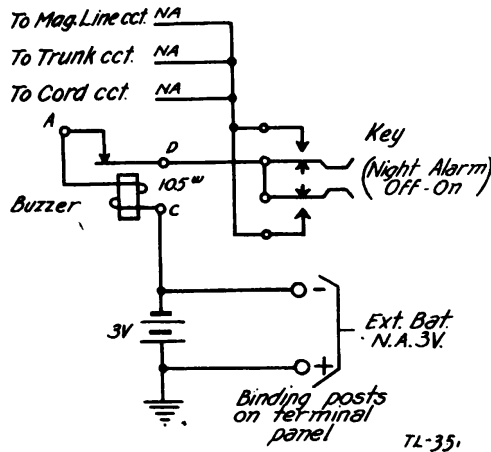


Figure 13. - Night alarm circuit.

Conference Circuit

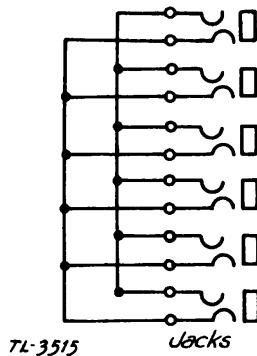


Figure 14. - Conference circuit.

15. CONFERENCE CIRCUIT. - Reference figure 14. This circuit consists of six jacks wired in parallel for the purpose of connecting together a number of lines for conference purposes. Cord circuits or patching cords are used for connecting the various lines to the con-

ference circuit. At the completion of a conference call, any party ringing-off causes all associated supervisory drops to fall.

16. MASTER SCHEMATIC DIAGRAM. - Figure 15 shows all schematic circuits encountered in switchboard BD-96. This figure will be of assistance in clarifying the relationship and interconnection between the various circuits.

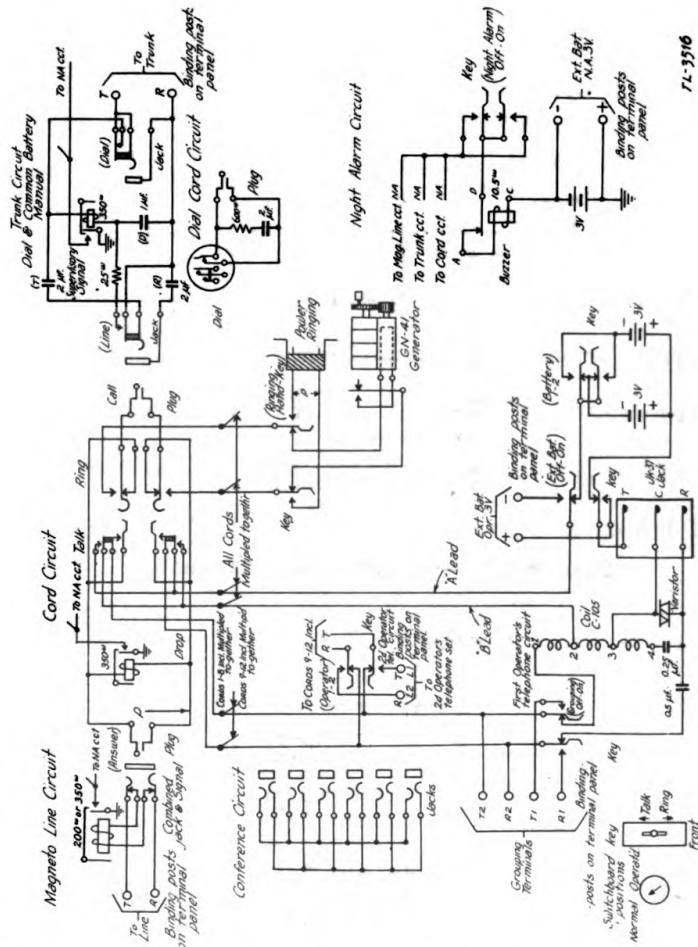


Figure 15. - Switchboard BD-96, master schematic diagram.

17. PANEL BD-97. - a. The arrangement of the apparatus is shown in figures 2 and 3. An opening with a sliding cover is provided for incoming line wires in each side of the panel. An opening with a sliding cover is also provided in the bottom of the upper cabinet for the cables

to the switchboard when the cabinet door is closed. Eight repeating coils C-161 are mounted four on each side of the protectors.

b. The cabling between the panel and the switchboard consists of three rubber jacketed cables each containing 15 pairs of braidcovered latex insulated, No. 22 AWG standard conductors. The cables, exclusive of the cable connectors, are 21 feet in length. The cable is connected at the panel directly to the fuses. At the switchboard end the cables are terminated in cable connectors which consist of strips of insulating material between which is mounted a row of 30 spade terminals of Signal Corps design. The spade terminals are mounted so as to allow some movement so that they will be self-aligning when connections are made to the binding posts on the switchboard terminal panel. The cable conductors are soldered to these spade terminals. The soldered connections are inclosed in a copper-alloy protecting cover.

c. Two vertical rows of 22 pairs of 1-ampere fuses and protector blocks (unit dischargers) are mounted in the panel. Two terminal strips, each with 44 binding posts of Signal Corps design, are mounted to each side of the panel for connecting the incoming line wires. These terminals are permanently wired to the line side of the fuses and protector blocks.

18. POWER RINGER, 20-CYCLE. - a. A Telering or equivalent 20-cycle power ringer is provided in the lower cabinet of panel BD-97. The Telering may be used for a source of ringing power when 110-volt, 60-cycle a-c power is available. A cord for making the connection to the power outlet is wired to the power ringer. Another cord is provided for extending ringing current to the switchboard.

b. The Telering 20-cycle power ringer is a vibrating reed type of frequency converter. The reed vibrates between a contact screw and an electromagnet. The contact screw is set at the factory, and it is

suggested that no change be made in the adjustment unless the reed vibrates in a surging manner or there is sparking at the contact. If sparking occurs, it requires only the slightest turn on the contact screw either inward or outward to correct it. However, it is seldom that any change will be necessary. The adjustment of the Telering contact is practically opposite to that of other vibrating type power ringers, in that the contact gap in the Telering must be kept as wide as possible. Closing the contact gap does not increase the output, but instead will upset the adjustment, causing sparking, interfere with radio reception, and may prevent starting. (See fig. 16.)

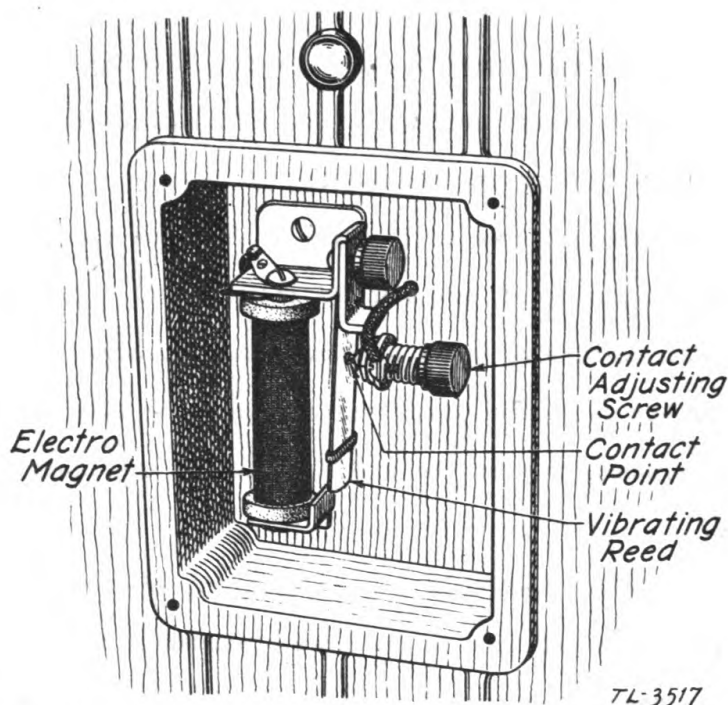


Figure 16. - Telering 20-cycle power ringer, cover removed showing vibrator assembly.

SECTION IV

SERVICING AND REPAIR

Paragraph

Maintenance----- 19

Packing for army transportation----- 20

19. MAINTENANCE. - a. The greatest single factor in trouble-free operation is careful handling of the equipment while packing and unpacking, transporting and installing. Test all circuits after the installation has been completed. If the equipment is being kept in storage, test all circuits at least once each month, or more often where climatic conditions warrant. Inspect all fuses and protector blocks (unit dischargers) each time the circuits in the switchboard are tested.

b. Test the magneto line drops and the trunk drops for proper operation, on incoming calls, by ringing through several miles of field wire or through an artificial line composed of noninductive resistors. A suitable artificial line may be readily constructed from two resistors, one of 80-ohms resistance, and the other of 1000-ohms resistance. Connect the two resistors in series and use as a potentiometer. A telephone EE-8-A connected across the 1080-ohms resistance (the two resistors in series) may be used as a source of ringing power. Low potential testing voltage is obtained by making connection across the 80-ohm resistor. Connect the leads from the two ends of the 80-ohm resistor to the line terminals of the drop to be tested. The test may be made at the most convenient point. In case a line or trunk is connected to the drop undergoing test, open the line or trunk at the line terminals in panel BD-97. After completion of the test, reconnect the line or trunk.

c. In order to maintain high grade transmission through the cord circuits, clean all plugs as often as required to maintain brightness, using a light oil and cake rouge, or a paste type metal polish.

The use of light oil and cake rough is the more preferable method of polishing plugs, as there is less tendency to use an abnormally large amount of polishing material. It is also easier to remove the unused portion of the polishing material from the plug upon completion of polishing. Pour a few drops of oil on the cake or rouge, thereby soft-

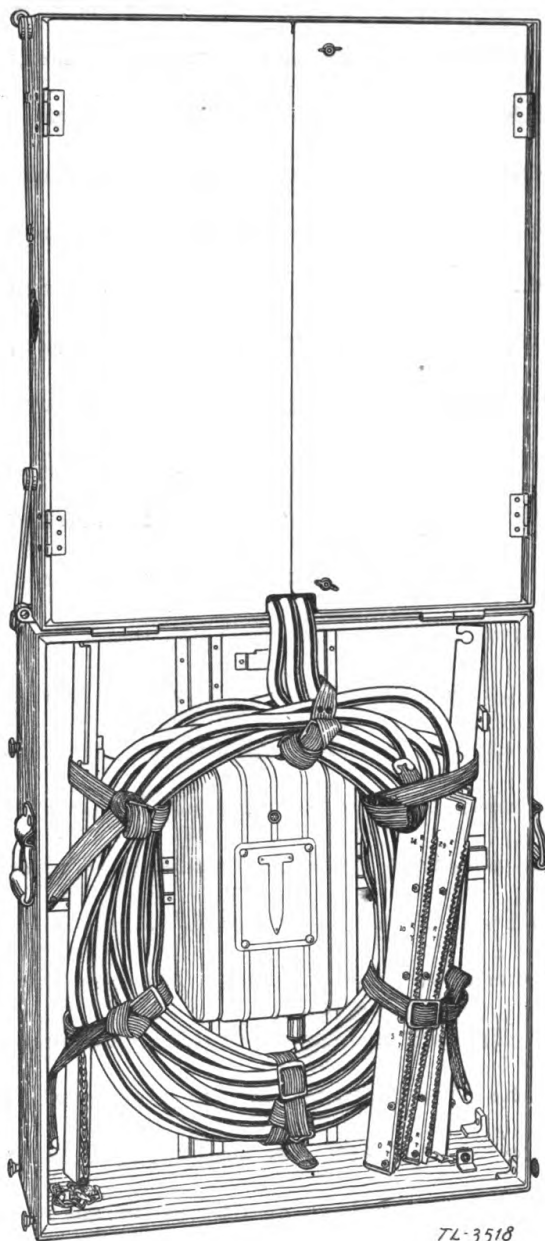
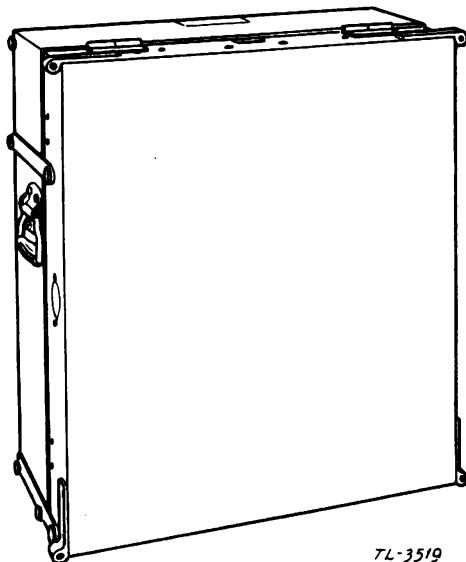


Figure 17. - Panel BD-97, cables secured for transportation.

ening the rouge to such an extent that when the polishing rag is rubbed across the surface of the cake, a small amount of rouge is transferred to the rag. Care must be taken when using either rouge or paste type of polish, to make sure that all surplus polishing material is thoroughly removed from the plug upon completion of the polishing operation.

20. PACKING FOR ARMY TRANSPORTATION. - Remove the spade-terminal strips from the switchboard and coil them and the associated cables with the ringing machine cords in the lower cabinet of the panel BD-97. (See fig. 17.) Close and fasten the upper cabinet doors. Remove the legs from the panel and strap them on the sides with the cables and ringing power cords. Close the panel and fasten with the bars. (See fig. 18)



7L-3519

Figure 18. - Panel BD-97 packed for transportation.

Adjust the designation strips on the switchboard BD-96 to clamp the line and trunk drops in place. Remove the seat top from the switchboard cover, pack the operator's head and chest set in the cover, and fasten the cover in place on the switchboard. (See fig. 19.) The batteries should be removed to prevent corrosion of the switchboard. Unclamp the switchboard from the base and turn upside down to facilitate packing the cords and

Signal Corps

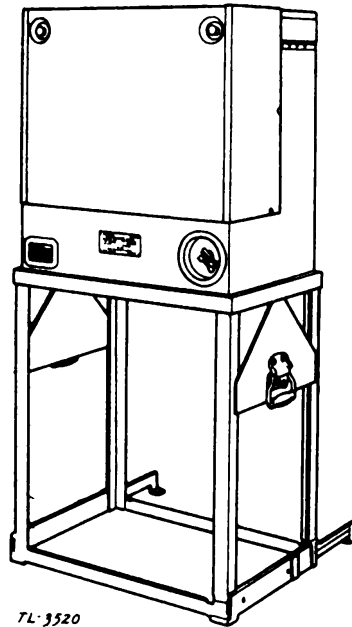


Figure 19. - Switchboard BD-96, front cover in place.

cord weights in the switchboard. Turn the switchboard right side up and place the base over the switchboard. Carefully turn the switchboard and base over and clamp the seat top in place. The switchboard may then be returned to its proper position. (See fig. 20.)

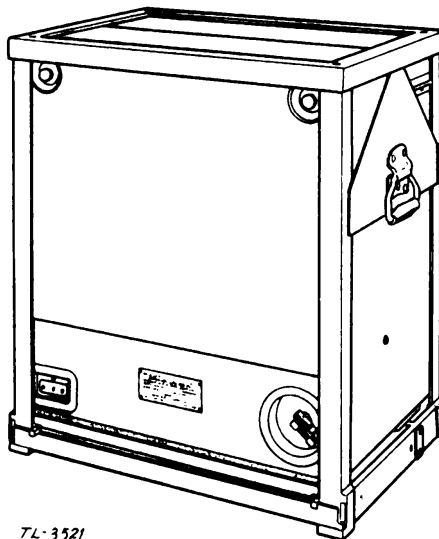


Figure 20. - Switchboard BD-96 packed for transportation.

SECTION V

REPLACEMENT PARTS

	Paragraph
List of parts-----	21
Addresses of manufacturers-----	22

21. LIST OF PARTS. - The following list of major component parts is further expanded in succeeding subparagraphs dealing with the larger items of equipment.

a. Telephone central office set TC-4, complete and composed of the following items:

Stock No.	Name	Description	Function	Ref. par.
4C9996.6	Switchboard	BD-96	Switching central	21b
4E3697	Panel	BD-97	Distributing and protector frame	21c
3A30	Battery	BA-30	Furnish voice current	
3E2258	Cord	CO-258	Ground connection	
3E1451	Cord	CD-451	Ringing power	
5B4416	Ground rod	GP-16	Ground	
4B1279	Head and chest set	HS-19	Operator's set	21e
4C5611	Maintenance equipment	ME-11	Storage for spare parts and tools	21d
627510-1	Paulin	Duck, type I 12.3 ft. by 16 ft.	Covering equipment	
4B5008	Telephone	EE-8-A, field, portable.	Auxiliary operator's set	

Signal Corps

b. Switchboard BD-96. -

Ref. Fig. No.	Stock No.	Name	Description	Function	Mfr.	Mfr's Part No.	Dwg. No. Signal Co.
7	32297	Binding post	TM-197	Line terminals			SC-D-4469
7	4C4623C-1	Jack and Signal, Combined	Mounted 5 per strip	Magneto line circuit	SCTM or W.E.Co.	D-3226 23C	SC-D-4458 SC-D-4458
8A	32297	Binding post	TM-197	Trunk terminals			SC-D-4469
8A	3DB1.41A	Capacitor	1- μ f	Blocking	W.E.Co.	441A	SC-D-4467
8A	3DB2.39A	Capacitor	2- μ f	((T), Blocking (R))	SCTM or W.E.Co.	D-3246 139A	SC-D-4467
8A	4C9996.6/J1	Drop	350-ohm	Trunk signal and holding bridge	SCTM or W.E.Co.	D-3249 34C	SC-D-4481
8A	4C9996.6/J1	Jack	Cut-off	Dial	SCTM or W.E.Co.	D-3272 237A	SC-D-4461
8A	4C9996.6/J2	Jack	Circuit closing	Line	SCTM or W.E.Co.	D-3250 215A	SC-D-4461
8A	4C9996.6/R2	Resistor	25-ohm	Capacitor discharger	SCTM or A.E.Co.	D-3232 D-281867 except 25-ohms	SC-D-4467
8B	3DB2.39A	Capacitor	2- μ f	Contact Prot.	SCTM or W.E.Co.	D-3246 139A	SC-D-4467
8B	3ES24K	Cord	5 ft, 2-cond.	Dial Cord cir- cuit	SCTM	S-24-K	SC-D-4448
8B	4BF795	Dial	A.E.Co. Cat. #AK-41		A.E.Co.	24A36	SC-D-4458
8B	4C6248	Plug	FL-48				SC-D-4448
8B	3Z5818AE	Resistor	600-ohm	Contact Prot.	W.E.Co.	18AE	SC-D-4467
9	3ES24K	Cord	5 ft, 2-cond.	Cord circuit	SCTM	S-24-K	SC-D-4448
9	4C9914.5/16	Drop	350-ohm	Cord supervisory signal	SCTM or W.E.Co.	D-3227 56B	SC-D-4458 SC-D-4458

9	4C9996.6/K1	Keys	Lever type	Talk-ring	SCTM or W.E.Co.	D-3229 CLW 47-A	SC-D-4463 SC-D-4463 SC-D-4468
9	4C6248	Plug	FL-48	Cord circuit	W.E.Co.	7466	SC-D-4469
10	6Z815	Base	Widget, flush	Ring power cord	Hubbell	7466	SC-D-4469
10	4B456	Crank	GC-12	Gen. operation			SC-D-4448
10	4B841	Generator	GN-41	Ring current			
10	4C9996.6/K2	Key	Turn-button type	Supply Emergency	SCTM or W.E.Co.	D-3228 498M	SC-D-4458
11	3Z239	Binding post	TM-139	External Battery and Grouping terminals			SC-D-4469
11	3DA250-7	Capacitor	0.25- μ f	Hlocking	W.E.Co.	141D	SC-D-4467
11	3DA500-20	Capacitor	0.50- μ f	Hlocking	W.E.Co.	141B	SC-D-4467
11	3C105	Coil	C-105	Induction Coil			SC-D-4467
11	4C4277	Jack	JK-37	Operator's set			SC-D-4448
11	4C9996.6/K2	Key	Turn-button type	Battery 1-2, External Battery	SCTM or W.E.Co.	D-3228 498M	SC-D-4458 SC-D-4458
11	4C9996.6/V1	Varistor	Receiver shunting	Grouping Acoustic shock reduction	W.E.Co.	44A	SC-D-4467
12	3Z239	Binding post	TM-139	Second operator's telephone terminals			SC-D-4469
12	4C9996.6/K2	Key	Turn-button type	Second operator	SCTM or W.E.Co.	D-3228 498M	SC-D-4458 SC-D-4458
13	4C1707B	Buzzer	Turn-button type	Night alarm	W.E. Co.	7BW	SC-D-4466
13		Key		Night alarm key	SCTM	D-3228	SC-D-4458
13	3Z239	Binding post	TM-139	Night alarm external battery	or W.E.Co.	498M	SC-D-4458 SC-D-4469

b. Switchboard HD-96. - cont'd

Ref. Fig. No.	Stock No.	Name	Description	Function	Mfr.	Mr's. Part No.	Dwg. No. Signal C.
14	4C4823A	Jack	Group mounted	Conference circuit	SCM	144	SC-D-4458
	4C9996.6/B3	Bolt, cabinet	Cast brass	Cord weight door bolt	or W.E.Co. Corbin	223	SC-D-4458
	6L605-1.5-1	Bolt	1-9/16 inch overall 5/16 x 2 1/4 thread			125	SC-D-4449
	4C9996.6/B4	Bracket	Keyshelf, steel				SC-D-4463
	4C9996.6/B5	Bushing	Natural phenolic rod	Generator mounting insulator			SC-D-4475
	4C9996.6/C1	Case, battery	Steel				SC-D-4448
	4C9996.6/B2	Door, back	With circuit label				SC-D-4449
	4C3709	Fastener, cord form	Timed brass	Cord terminal	W.E.Co.	9	SC-D-4466
	4C9996.6/F2		Laced	Line and trunk cable			SC-D-4479
	4C9996.6/F1	Form	Laced	Main cable			SC-D-4479
	4C9996.6/G2	Guard, dial	Steel				SC-D-4475
	4C4247B	Hook, cord	1 1/4 per strip				SC-D-4466
	4C9996.6/G1	Insulator	Natural phenolic plate	Generator base	W.E.Co.	7B	SC-D-4475
	4C9996.6/L1	Leg assembly, right	Leg, spring and button assembly	Support			SC-D-4477
	4C9996.6/L2	Leg assembly, left	Leg, spring and button assembly	Support			SC-D-4477
	4C9996.6/L3	Lugs	Soldering				SC-D-4469
	4C9996.6/T2	Mounting	Jack and signal	Used with TM-139 Cinch Trunk circuit		1431	SC-D-4458
	4C9996.6/N1	Nut, wing	5/16 inch, 2 1/4 thread				SC-D-4449
	4C9996.6/P6	Pad, felt	1-3/8" x 1-1/8" x 1/4"		Continental	5888	SC-D-4470
	4C9996.6/P5	Pad, felt	12-1/4" x 3" x 1/4"		Continental	5888	SC-D-4470
	4C9996.6/F1	Panel	Steel	Equipment protection			SC-D-4449

4C9996.6/P3	Plate, designation	Brass		SC-D-4458
4C9996.6/P2	Plate, insulator	XXX-black phenolic	Night alarm bus bar insulator	SC-D-4458
4C9996.6/P4	Plate	Black phenolic	Keysheff, right end	SC-D-4463
	Plate	Black phenolic	Keysheff, left end	SC-D-4463
4C9996.6/R1	Retainer	Steel	Supervisory drop retainer	SC-D-4458
4C9996.6/S2	Screw	FHB, 1-9/16", 1/4 x 28 thread	Keysheff retaining screw	SC-D-4463
4C9996.6/S3	Screw	Oval head, 15/64", 10-32 thread	Keysheff bracket screw	SC-D-4463
4C9996.6/S1	Seat assembly			SC-D-4446
4C9870	Strip, designation	5-3/4 inch		SC-D-4458
4C9996.6/T1	Table assembly	Cupped, steel	Keysheff retaining screw washer	SC-D-4446
4C9996.6/W2	Washer	Soft rubber	Generator shaft dust protector	SC-D-4463
4C9996.6/W1	Washer	Insulating Flat, 8 to 11 ess. Cotton	Generator mounting Cord return Cable clamp	SC-D-4448
4C9996.6/W3	Washer			SC-D-4475
4C29100	Weight, cord			SC-D-4448
4C28895	Webbing			SC-D-4463

W.E.Co. 8M

c. Panel BD-97. -

Ref. Fig. No.	Stock No.	Name	Description	Function	Mfr.	Mfr's. Part No.	Dwg. No. Signal C.
	3Z296	Rinding post	TM-196	Line and trunk terminals			SC-D-4493
	3C161	Coil	C-161	Repeating coil			
	3E1427	Cord	CD-427	Line and trunk connections to BD-96			SC-D-4495
	3Z2432	Fuse	1-ampere	Sneak current protection	Cook	A-12	
	4E682.1	Protector block	Carbon (unit discharger type)	High potential protection	Cook	2612	
		Protector unit	Mounting only, less screws and nuts		Cook	1040-H-51 modified	
	4C9996.6/T3	Strip	Terminal	Line connection			SC-D-4492 Gr 1
	4C9996.6/T4	Strip	Terminal	Line connection			SC-D-4492 Gr 2
	4C9996.6/T5	Telering	110-volt	Power ringing machine	Telkor	Model H	
	4C9996.6/S4	Strap	Web	Securing CD-427 during transportation			

d. Maintenance equipment ME-11. -

Quantity	Stock No.	Name	Description	Function	Mfr.	Mfr's. Part No.	Dwg. No. Signal C.
10	3E1298/1-1	Angle	For connector of cord CD-427	Spare			SC-D-4494
1	62815	Base	Connector widget, flush	Spare	Hubbell	7466	SC-D-4469
10	3Z296	Binding post	TM-196	Spare			SC-D-4493
12	3Z297	Binding post	TM-197	Spare			SC-D-4469
1	6Z1735	Cap	Cord grip	Spare	Hubbell	9754	
1	4C2965	Chest	CH-65				SC-D-5091
1	6Z3151	Connector	Power	Spare	Hubbell	7464	
1	3E2258	Cord	CO-258	Spare			SC-D-4271
50 ft.	3E2130	Cordage	Rubber covered, black, 2-conductor, #18 AWG	Spare	G. E. Co.	60 per-cent types A-12	
12	3Z2432	Fuse	1-ampere	Spare	Cook		SC-D-4311
2	3Z3329	Ground rod	GP-29	Spare			000-H-86
1	6Q49005	Hammer	HM-5, sledge 12 lb.				
1	6Z6896	Lamp, with extension cord	25-ft. long		G. E. Co.	92282	
1	6Z6900A	Lantern	Electric, hand, Delta, with 2.4-volt miniature screw base lamp				
1 pr.	3F4056/11	Lead, test					
1	6Z7496	Padlock	MC-96 type 1a-2 inch		Weston	D-70033-4	
1	6R4513	Pliers	TL-13				
1	6R4603	Pliers	TL-103				
1	6R4626	Pliers	TL-126				
4 doz.	616832-12.5	Screw	Machine RHB, nickel, 3/4-inch, 8-32	Spare repeating coil mounting screws			

37

Telephone Central Office Set TC-14

TM 11-332
21

d. Maintenance equipment ME-11. - cont'd

Quantity	Stock No.	Name	Description	Function	Mfr.	Mfr's. Part No.	Org. No. Signal C.
1	6R19100	Screw driver set	TL-128, consisting of the following: (Quantity in parenthesis) Spiral ratchet 1/16" to 11/64" and chuck			30A	
(1) (8)	6R19030 6Q34900	Screw driver Drill points	Ratchet, 6-inch blade			11-6	
(1) (1)	6Q29230 6R19011	Countersink Screw driver	Ratchet, 3-inch blade			15-3	
(1)	6R19015	Screw driver	Size 1 1/2, 3/4 lb., with handle				
1	6R24512H	Soldering iron	TL-117				
1	6R24617	Soldering iron					
		Soldering iron holder			Vulcan	2100	
1	3F4065A	Test set	EE-65-A				
1	6R42167	Torch	TL-130				
12	4E682.1	Protector block	Carbon (unit discharger type)	Spare	Cook	2612	
1	3F4056A/V1	Volt- ohmmeter	Type 3C 0-100, 000 ohm, 0-300-600v d-c		Weston	Model 564	
4 doz.	4B5004/111	Washer, split, spring	#8 SAE regular, nickel-plated	Spare, for mounting re- peating coils			
4 doz.		Washer	#8 SAE regular, nickel-plated	Spare, for mounting re- peating coils			
1	6R55006	Wrench	TL-111				

e. Head and chest set HS-19. -

Stock No.	Name	Description
4B418	Chest unit	T-26, composed of the following items (Stock number in parenthesis):
(4Z6924)	Strap	ST-24
(4Z6925)	Strap	ST-25
(3Z8118)	Switch	SW-118
3E333	Cord	CC-333, 6-foot, 3-conductor
3E337	Cord	CC-337, 20-inch, 2-conductor
4C4153BA	Headband	
4C4153BA/1	Pad	Leather
4B2358	Plug	PL-58
4B2522	Receiver	R-22

f. Switchboard plug cleaning material. Used with, but not included as a part of telephone central office set TC-4.

Stock No.	Name	Description
6G1315	Oil, light	3-ounce can (3-in-1)
6G1516	Polish, metal	Paste, 2-ounce box
	Rouge	Cake, jewelers'

22. ADDRESSES OF MANUFACTURERS. -

A. E. Co.	Automatic Electric Co.	Chicago, Illinois
Cinch	Cinch Manufacturing Co.	Chicago, Illinois
Continental	Continental Felt Co.	19th St. and Broadway, New York, N. Y.
Cook	Cook Electric Co.	Chicago, Illinois
Corbin	P & F Corbin Co.	New Britain, Conn.
G. E. Co.	General Electric Co.	Schenectady, N. Y.
Hubbell	Harvey Hubbell, Inc.	Bridgeport, Conn.
SCTM	Stromber-Carlson Telep. Mfg. Co.	Rochester, N. Y.
Telkor	Telkor, Inc.	Elyria, Ohio
Vulcan	Vulcan Electric Co.	Lynn, Mass.
W. E. Co.	Western Electric Co.	Chicago, Ill.
Weston	Weston Electrical Instrument Co.	Newark, N. J.

Signal Corps

(A. G. 062.11 (4-25-42).)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

IBn 11 (2); IC 11 (10).
(For explanation of symbols see FM 21-6.)

